THE YOUNG VOLCANIC REGIONS OF SOUTHEASTERN AUSTRALIA: EARLY STUDIES, PHYSICAL VOLCANOLOGY AND ERUPTION RISK

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JOYCE, B. 2005. The young volcanic regions of southeastern Australia: Early studies, physical volcanology and eruption risk. *Proceedings of the Royal Society of Victoria* 117(2):329–332. ISSN 0035-9211. Corrigenda from 116(1):1–13. ISSN 0035-9211.

The young volcanic regions of southeastern Australia, known as the Newer Volcanic Province, can be divided into four main subprovinces. The Western Plains subprovince and the Mt Gambier subprovince in southeastern South Australia occupy broad plains, while the Western Uplands subprovince is the elevated east-west spine of Western Victoria, with the Great Divide running along its crest. Small areas of youthful volcanism are also found in the Eastern Uplands subprovince.

Beginning about 6–7 Ma ago, but mainly since 5 Ma, a new volcanic province formed on both the Uplands and the Plains, and nearly 400 small, monogenetic scoria cones, maars and lava shields have been built up by Strombolian/Hawaiian eruptions. Fluid basalt flows have spread laterally around vents, often for many tens of kilometres down river valleys. Where the lava flows have blocked drainage, lakes and swamps have formed. Phreatic eruptions have deposited ash and left deep craters, often now with lakes. The study of the province began in 1836, and now, over a century and a half later, while the cause of activity still remains unexplained, future activity is believed to be likely.

Keywords: volcanology, exogenic landscape, history, catalogue, dating, eruption risk, Australia.

ERUPTION RISK

If activity in the Newer Volcanic Province (NVP) (See Fig. 1) had been regularly spaced over time, simple arithmetic (400 volcanoes in 5 Ma) would suggest there had been an eruption every 12,500 years. The most recent eruption which has been dated is Mt Gambier, at 4000–4300 B.P. (Blackburn et al. 1982), so on that basis we are well within the possible period for future activity.

Some lava flows have been dated by K/Ar, radiocarbon, and other isotopic techniques, but others have not. A more detailed chronosequence of lava flows, cones and craters can be built up by studying the changes in landforms, drainage, soil and regolith over time, using field mapping, air photos and satellite imagery, and new airborne geophysical imagery (Joyce 1999). Such work is helping assign ages to otherwise undated flows, and we seem to be seeing cycles of activity through time, notably a period of more concentrated activity in the late Quaternary in far Western Victoria (Joyce 2001a). Perhaps a dozen volcanoes may have erupted within the last 20,000 to 30,000 years — this would be an eruption every 2,000 years or so. However if vents were clustered into groups erupting about the same time, as seems likely, there may have been somewhat longer periods between each group of volcanoes.

Future eruptions

Australian volcanologists agree that further eruption is possible (Blong 1989), and may well be overdue. A future eruption would not be the renewal of activity at an existing volcano, but the initiation of a new volcano. The pattern of age distribution in the NVP can be used to suggest where a future eruption is most likely (Fig. 2).

Little warning of an eruption would be expected. Minor seismic activity with small earthquakes might precede the eruption by some weeks, and there could also be minor uplift or subsidence of the ground surface, and perhaps changes in ground temperature, and the exhalation of volcanic gases and steam.

The types of eruption to be expected are:

- maar crater formation by phreatic eruption, with radial base surge ash flows, and ash falls for several kilometres downwind i.e. to the east;

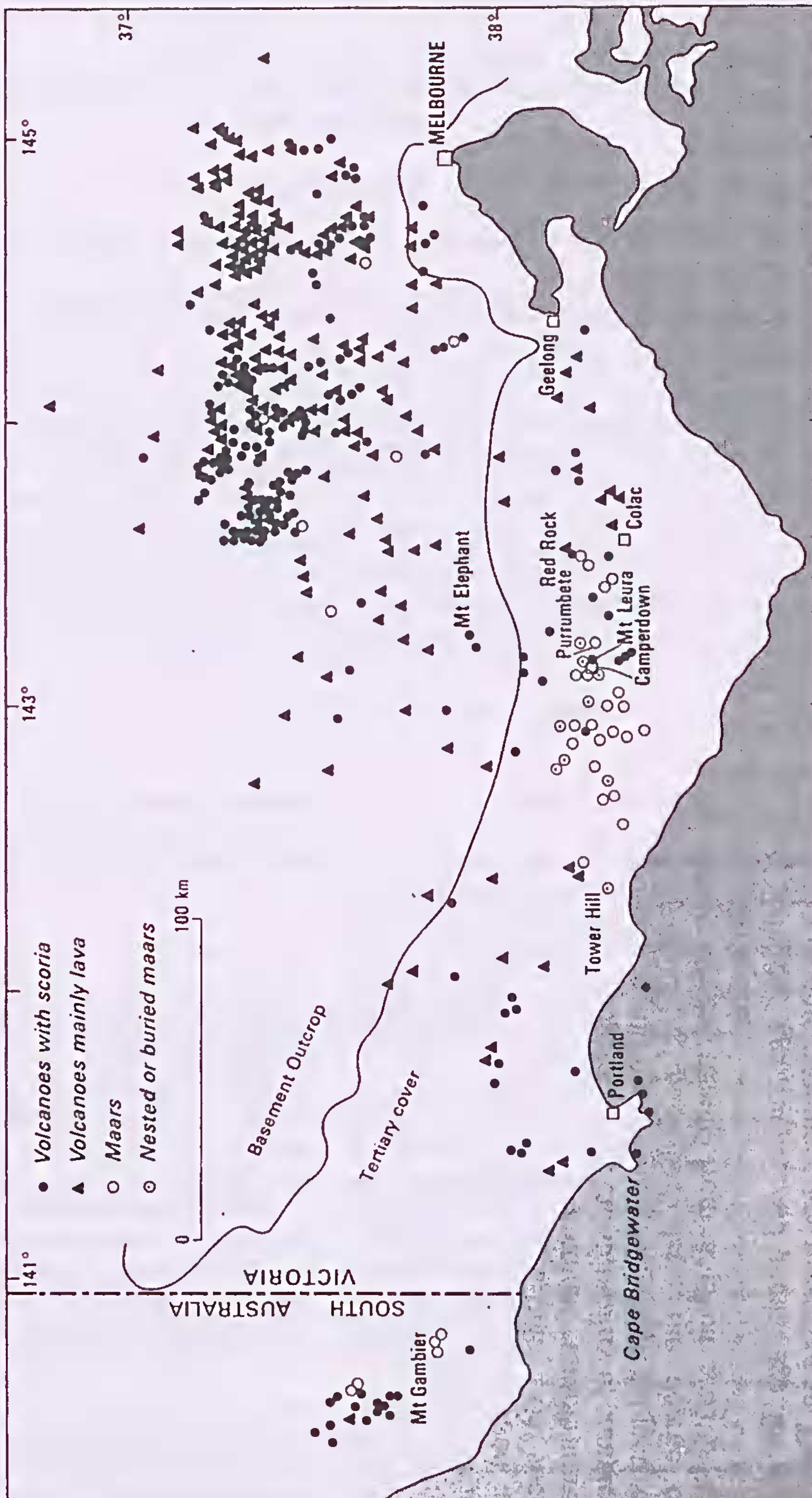

Fig. 1. Volcanoes of the main parts of the Newer Volcanic Province by type, based on Joyce 1975 (Johnson 1989)

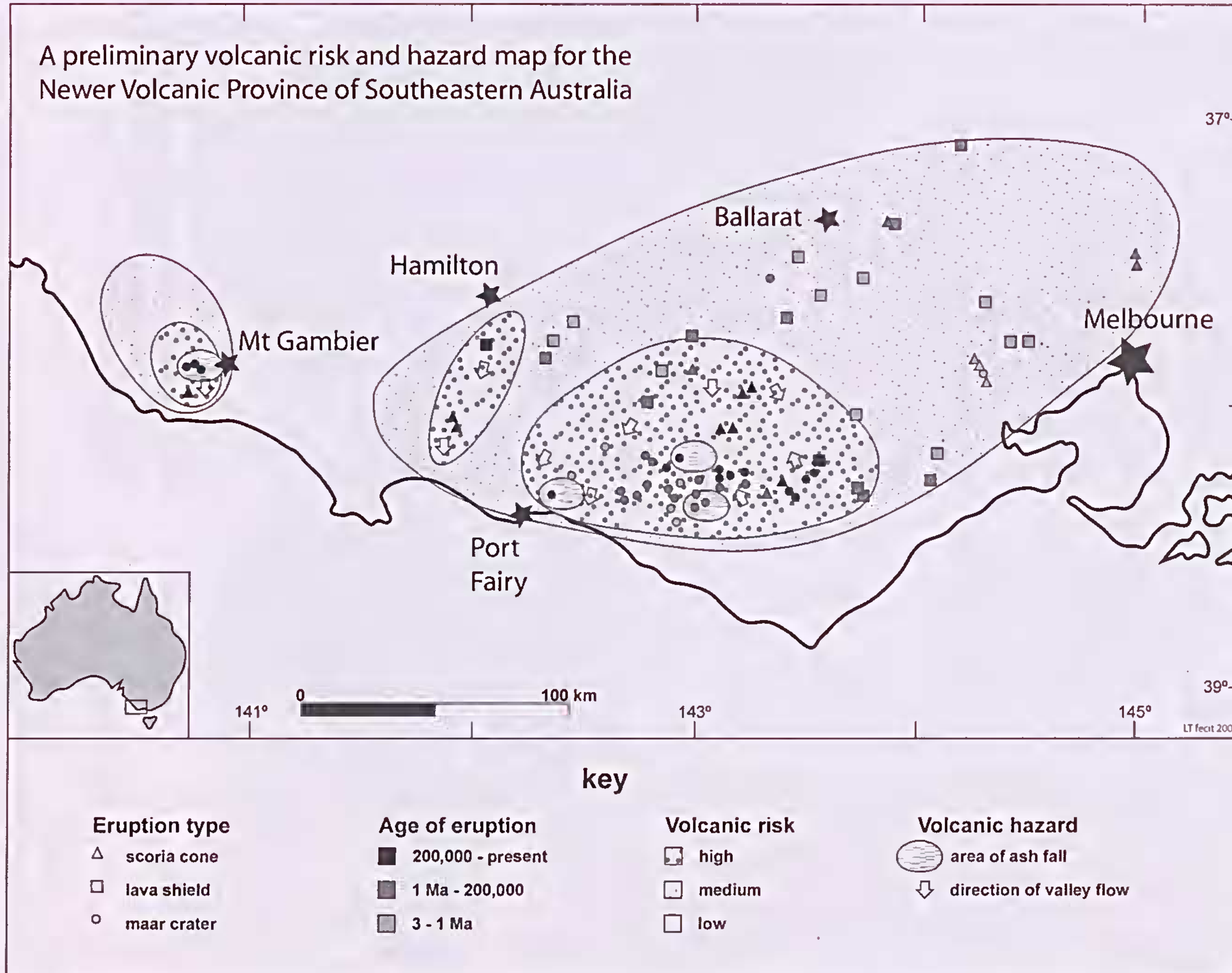

Fig. 2. Mapping of eruption types and ages with an indication of volcanic risk and hazard for the Newer Volcanic Province (after Joyce 2001a)

- cinder/scoria cone formation by fire-fountaining; and
- lava shield building and associated long valley flows.

Field studies have shown that these three types may occur separately, or in combination. For example an initial maar eruption may be followed by cone building within the maar crater (Tower Hill), or a series of lava flows and the building of a lava shield may be followed by scoria cone formation (Mt Napier).

Such activity might last for weeks or months, or for some years. If vents are clustered, successive eruptions, perhaps of different types, may occur near an initial eruption site, thus affecting a wider area for a longer period. Fumarolic activity and minor gas and ash eruption may continue for many years after the end of the main eruptions.

Maar activity upwind of a town or one of the major cities of the region, such as Melbourne or Ballarat, would provide particular problems from ashfall and base surge flows. In contrast, lava flows would follow the general slope and mostly move southwards down pre-existing valleys (Fig. 2). Hazard impacts of lava and ash would include property and infrastructure damage; effects on people, farm animals and crops; water pollution and stream derangement; and grass and forest fires. There could be associated earthquakes and ground deformation. Emergency management would be concerned with evacuation planning, diversion or control of flows, removal of ash and scoria from roofs and roads, control of fires and floods, and the repair and rebuilding of infrastructure, especially roads and bridges (see discussion in Blong 1984). A risk and hazard map (such as in Joyce 2003) can suggest where a future eruption might occur (Fig. 2). Government bodies should plan for preparedness and mitigation, and eruption scenarios should be developed and publicised. Public education will be necessary, both within the local community, and for planners within local government and emergency organisations (Joyce 2001b).

FUTURE STUDIES

Intraplate volcanism is widespread around the world, but a major problem is explaining why such activity occurs. The detailed information now available for the NVP makes it an ideal region to attempt to solve this problem (see discussion in Price et al. 2003, Cas 1989, Johnson 1989).

The geological heritage values of the NVP are well documented (Joyce & King 1980, Joyce & Webb 1993) and can provide an important way of promoting hazard and risk concepts to the local inhabitants (Joyce 2001b). Recent threats to this heritage, which is of national and international significance, include quarrying (Mt Leura), housing development (Lake Gnotuk, Mt Aitken) and landform destruction (Byaduk lava flow from Mt Napier). New reserves have however been developed at Mt Elephant and Mt Rouse volcanoes, and there have been recent improvements to interpretation at other sites (Mt Leura, Byaduk flow), and the development of the Volcanic Trail across much of Western Victoria. A recent National Trust landscape study of the Stony Rises, and the establishment of the Volcano Discovery Centre at Penshurst, near Mt Rouse volcano, are also promising developments. In the future the integration of volcanic research, local history study, and heritage interpretation could be the key to developing a greater awareness, not just of heritage values, but also of volcanic risk and hazard in the Newer Volcanic Province of southeastern Australia.

ACKNOWLEDGEMENTS

Local and overseas colleagues, and many research students, have worked on aspects of the Newer Volcanic Province, and their ideas have emerged in publications, theses and lectures. Ideas have also developed in the field, and sometimes later in the pub. Cliff Ollier introduced me to the NVP and we have published papers together. The many Honours students who have mapped and described individual volcanoes over the past 30 years have helped continue my education. I thank Chris Turney and Jim Peterson for valuable comments on the final draft of this paper. And I gratefully thank Peter Kershaw for his enthusiasm in getting it all to fruition.